DOCUMENT RESUME

ED 442 956 CE 080 363

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TITLE	Reconfiguring Basic Computer Occupations: Between Technology and Service.
INSTITUTION	Centre d'Etudes et de Recherches sur les Qualifications, Marseilles (France).
ISSN	ISSN-1156-2366
PUB DATE	2000-00-00
NOTE	6p.
AVAILABLE FROM	Cereq, 10 place de la Joliette, 13567 Marseille cedex 02, France, Tel: 33 4 91 13 28 28.
PUB TYPE	Collected Works - Serials (022) -- Reports - Descriptive (141)
JOURNAL CIT	Training & Employment: A French Newsletter from Cereq and Its Associated Centres; n36 Sum 1999
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	*Computers; *Education Work Relationship; Educational Needs; *Educational Policy; Employment Patterns; Employment Qualifications; Entry Workers; Foreign Countries; Glossaries; Industrial Structure; Instructional Development; Job Training; Needs Assessment; Policy Formation; Postsecondary Education; Secondary Education; *Service Occupations; Technical Institutes; *Technical Occupations; Technological Advancement; Trend Analysis; *Vocational Education
IDENTIFIERS	*France; Impact Studies

ABSTRACT

The nature of basic computer occupations has changed greatly since the early 1980s. The changes reveal a shift in the respective roles of the sectors of industry associated with computer services (manufacturing and industrial computing). The service sector has adopted the procedures of industry in terms of organization, methods, and quality, whereas the manufacturing sector has had to assimilate the culture of services (including taking the totality of customers' needs into account and structuring a service supply). The industrial computing occupations have adopted standard technologies to their particular needs. These trends have affected France's vocational training policy and have necessitated choosing between technology- or occupation-based approaches to preparing learners for basic computer occupations. Currently, training for entry employment in computer occupations in France targets an occupation, an area of application, or a technology. Considering the changes that have occurred in the nature of basic computer occupations and the ways computers are being used, an occupation-based approach would offer the advantage of harmonizing employment qualifications, reducing their number, and avoiding the risk of several qualifications covering the same job targets. It would increase the complementarity of the French educational system's training streams and those of the National Association for Adult Vocational Training. (MN)

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ED 442 956

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Training and Employment
No. 36, Summer 1999

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Training & Employment

A FRENCH NEWSLETTER FROM CEREQ AND ITS ASSOCIATED CENTRES

RECONFIGURING BASIC COMPUTER OCCUPATIONS: BETWEEN TECHNOLOGY AND SERVICE

The changing nature of basic computer occupations reveals a shift in the respective roles of the sectors of industry (both manufacturers and industrial computing) and that of computer services. In order to ensure its expansion, the services sector has adopted the procedures of industry in terms of organisation, methods and quality. In order to ensure their survival, the manufacturers have had to assimilate in turn the culture of services, which involves taking the totality of needs into account and structuring a service supply. The industrial computing occupations, meanwhile, have adopted standard technologies (programming languages, systems and networks) to their particular needs. This dynamic, which is reconfiguring the basic computer occupations, is not without impact on vocational training policy, now faced with choices between technology- and occupation-based approaches.

In 1998, an estimated 300,000 people were working in computer occupations in France (excluding sales personnel and keyboard operators). But this breakdown is complicated by the lack of correspondence between the socio-economic classifications applied by INSEE (the French national statistics institute) and the new categories in use within the companies. Thus, the employers' organisation SYNTEC-Informatique, using the employers' categories, provided an estimate of 336,000 jobs in 1997. In any case, labour market observers agree on a sharp increase in these figures in 1999, which may be explained at once by the year 2000 rollover, the transition to the single European currency, the beginning of the economic recovery and the spread of new technologies such as the Internet and *client/server architecture.*[1]

Changes in the qualification structure corresponding to computer occupations reflect a trend that began in the early 1980s. The shift from centralised computer systems to increasingly diffuse ones, which goes back to the arrival of the first PCs, gradually led these occupations to align themselves with the economic players as a whole. Today's computer specialists can no longer rely solely on their technical knowledge; they are required to adapt themselves to a wide variety of interlocutors by absorbing the latter's culture and demands. And this phenomenon is reinforced by a parallel trend that is more recent: that of a general public which is becoming more familiar with standard technologies and environments (office computers, Internet) through the massive distribution of computer goods for both professional and personal use.

FROM DEVELOPMENT TO ASSISTANCE: CONTINUITY AND CHANGE

The main feature of basic computer occupations is the fact of being accessible immediately after the completion of an initial training programme (such as those leading to the higher technician certificate [BTS] or technical diploma [DUT]) or a vocational one (from Level IV to Level III for qualifications acquired through the Association nationale pour la formation professionelle des adultes [National Association for Adult Vocational Training, AFPA]). For this reason, such occupations do not entail the functions and skills that are essentially developped through work experience, notably supervisory posts (project head) or expertise (operations analyst, architect, etc.). In addition, they are always defined by real technical knowledge, which excludes sales personnel.

1. Technical terms which appear in italics are explained in the glossary on p. 4.

PLEASE NOTE: Because of unavoidable production delays, this issue of *Training and Employment* does not contain the usual news briefs and publication announcements. The regular eight-page format will be resumed with issue number 38.

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CENTRE D'ETUDES ET DE RECHERCHES SUR LES QUALIFICATIONS

These occupations can be grouped into three families situated between the production of software and the providing of services (cf. diagram below):

- Research and Development: This family clearly involves the greatest number of personnel. It consists of the basic occupation of "developer", which combines the former positions of programmer and programmer-analyst, or even analyst. The developer remains emblematic of all the computer occupations, but his or her field of intervention is no longer limited to the areas of industry and business alone.
- Production, Processing and Administration: Within this family, the occupation of "resources administrator" (networks or databases) is central, complementing the "operator", formerly the keyboard operator or operations technician.
- Maintenance, Support and Service: This family is the one where the reorientation towards the customer and user is most obvious, as can be seen from posts such as "user support" and "*Help Desk*".

This configuration brings out two major changes: the appearance of new forms of organisation for customer or user service and a convergence of the technologies used in all areas of application.

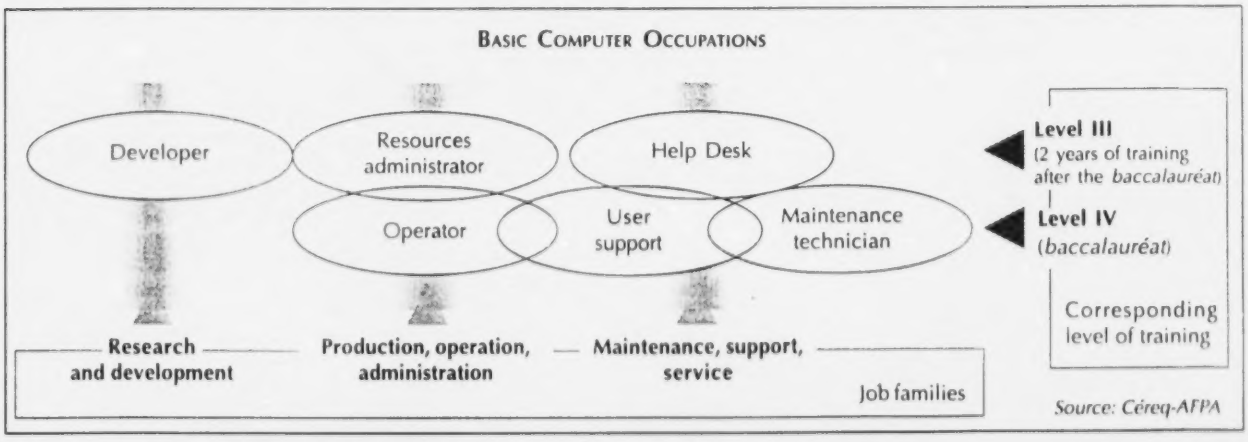
A NEW FORM OF ORGANISATION BASED ON CUSTOMER AND USER

Several years ago, the functions of the programmer, responsible for producing the software programme, and those of the analyst, specialised in describing the functions of this programme, could remain distinct within forms of organisation that were still based on Taylorism. The merging of these two functions is reflected in the current occupation of the developer, who often participates in initial meetings to define the customer's need with the project head. During the very process of elaborating the software, new methods of *rapid development*, based on *simulation* and *integration of components* permit the appropriateness of the application to the expectations of the customer to be verified via a constant dialogue with the latter. Moreover, the developer's work does not end with the elaboration or maintenance of applications (i.e., the software that has to be integrated into overall computer solutions). He or she is frequently asked to follow through on putting the applications into production, to train users or even to provide technical support. Nor is the technical aspect of this occupation diminished; the tools and environments required often remain unknown until the arrival of an order, which requires considerable technical involvement on the part of the developer in advance of each project.

The essential task of the administrator is to take over from the developer after a *software* programme or *package* goes into production. Traditionally, when he or she was designated by the term "operations head" or "operations technician", the major role consisted of ensuring the proper functioning of the centralised computer system, without direct interaction with users. The trend towards decentralisation of the systems and the dissemination of an entire new range of computer services (office automation, messaging, workgroup computing, databases) has limited this operations technician (also known as "operator") profile to large systems only. The administrator, by contrast, is in permanent contact with users and department heads in order to respond to all of their technical problems (such as access rights for a network server, the Internet or data extraction).

Individual computer terminals, which have become universal communications platforms, have led extremely diversified users to be ever more demanding in terms of breakdown service or rapid assistance, and to turn to a single interlocutor. At the same time, the companies are seeking to limit expenditures in this area, given that write-offs for hardware and software constitute only 20 percent of the annual cost of a computerised work station. In response, the supplies of manufacturers and *OEMs* has been restructured around the comprehensive services of the "Help Desk". This function covers all user-assistance operations: advice, hotline and on-site help, maintenance and so on. Three occupations now depend on this form of organisation:

- "Help Desk" receives requests for assistance coming from users and handles them itself or has them handled on-site by a maintenance technician. There is considerable turnover in this occupation, which may be attributed to the stress involved in the work, which is close to that of telephone operators. In fact, the Help



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Desk intervenes long distance and thus "mentally" on complex systems with the help of indications that may be very different depending on the profile of the correspondents involved.

- The "maintenance technician" carries out the necessary repairs on-site but is rarely involved in diagnoses. He or she is also called upon for the installation and connection of facilities and systems.
- The "user assistant" draws largely on the skills of the maintenance technician and Help Desk occupations, but also handles follow-up of a computer installation or daily operations.

A CONVERGENCE OF TECHNOLOGIES THAT REDUCES TRADITIONAL DISTINCTIONS

In computer occupations more than elsewhere, organisational changes are associated with major technological breakthroughs, which have also contributed to the restructuring process. The growing demand of service companies and businesses for reusable software has encouraged the development of universal languages. As a result, programming, which was formerly carried out with languages that were very specific to a field of application (i.e., COBOL for management, or the assembler for real-time data processing) now uses increasing numbers of languages common to industry and businesses, such as *"object-oriented" languages* (C++, Java, etc.).

The operating systems used by developers for the large majority of their software have undergone the same evolution. If a few systems specific to industrial applications still remain on the market, a growing number of software programmes use standard systems. The same is true for business data processing, where fewer and fewer owner systems (i.e., belonging to the major manufacturers, such as OS-400 for IBM) are in use. It should be noted, however, that the industrial specificity remains pronounced when the programmes are embedded in the equipment, as with cellular phones, for example. In this case, design and development occupations require a double competence in electronics and computer science and often correspond to an engineering qualification.[2]

In the area of computer networks, while manufacturers and service companies have long sought to promote local industrial networks, we can now observe increasingly frequent recourse to standard technologies such as *Ethernet* or the Internet, or, in the least, a greater penetration of these techniques into the industrial

2. See H. Eckert and P. Veneau, "Electronique, électro-technique, informatique industrielle : de la spécificité de formation au métier", Céreq *Bref* 152 (April 1999).

FROM ANALYSIS OF THE WORK SYSTEM TO CONSTRUCTION OF A TRAINING SYSTEM

The harmonisation of vocational training qualifications in computer science was requested in 1995 by the ministry in charge of vocational training and the Technical Commission for Homologation, and prepared in 1996 and 1997 by a work group including representatives of labour and management and the Association nationale pour la formation professionnelle des adultes (National Association for Adult Vocational Training, AFPA). In 1998, a first phase of this harmonisation consisted of studying the changes in jobs, activities and competences within the basic occupations in order to develop corresponding guidelines.

In this context, the AFPA and Céreq carried out a study on the basic computer occupations and their evolution, the main results of which are presented in this issue of *Training & Employment*.* For the analysis of work, this study relies mainly on the principles of the ETED method ("Emploi-Type Etudié dans sa Dynamique": typical job studied in its dynamic) that has been developped by Céreq.** Some one hundred individual interviews were carried out in all the computer branches, including about forty with specialists and heads of the companies surveyed and sixty with professionals in the occupations corresponding to the AFPA's training targets. Among the occupations (or typical jobs) identified, a distinction was made between those for which a qualification could be obtained through direct vocational training (the basic computer occupations) and those which were more likely to be targeted through advanced training (e.g., project head in development). Professional advancement towards the posts of application supervisor or project head, as well as the reskilling of computer specialists (for which a sharp demand was anticipated following the year 2000 rollover and transition to the Euro), are among the AFPA's preoccupations but remain marginal to the objectives of this study. Adult training programmes leading to the occupational qualifications of the Ministry of Employment and Solidarity are in fact aimed at jobs corresponding to the first levels of qualification. This study thus attempts to identify and analyse those jobs. It will permit the updating and harmonising of the AFPA's computer training streams in the context of its new training design, which separates the analysis of the system of work, on which the guidelines for qualifications and accredidations are based, from the development of the training system.***

Thus, throughout this year-long study, results were regularly presented to the AFPA's advisory bodies (national sub-commissions and advisory occupational commissions) including labour and management from the occupational branch that accredits the applications, in accordance with the guidelines of the Ministry of Employment and Solidarity. The AFPA has committed itself to a major effort in the field, because, in the long run, the entire stream should be brought up to date. Such an investment is justified insofar as computer science, which is emblematic of our society as a whole, brings together divergent interests (of manufacturers, software publishers, service companies, users) and makes any long-range approach difficult.

This study was carried out with the collaboration of M. Andribet, M. Cambraye, E. de Gaillard, Y. Derail, F. Diochin, M. Fruchard, M.-L. Haumant, P. Pérez and B. Vignal, members of the AFPA's Department of Technical Research and Support.

* The complete results of this study will be published in Summer 2000.

** Cf. N. Mandon, *La gestion prévisionnelle des compétences. La méthode ETED*. Document no. 57, "Etudes" series. Paris: Céreq, 1990.

*** Cf. *L'ingénierie de formation. Méthode et guides pratiques*. "Repères" series, "Methodes et organisations". Montreuil: AFPA, 1998.

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networks. Thus, one large urban transportation company is planning to automate its systems of ticket sales and control with the help of these network technologies and a standard operating system.
The client companies, meanwhile, have largely contributed to the trend towards the standardisation of computer tools and environments in order to guarantee the durability of their investments in this area.
The synergy of computers and telecommunications has also made a major contribution to the reconfiguration of computer occupations. The total digitisation of the telecommunications networks has in fact required massive recourse to computer tools and technologies, while computer networks cannot be set up without recourse to the telecommunications networks. It may also be noted that coupling techniques between telephone and computer technologies have permitted the creation of Help Desk structures within the call centres.

VOCATIONAL TRAINING, BETWEEN TECHNOLOGY- AND OCCUPATION-BASED APPROACHES

This reconfiguration of basic computer occupations constitutes a true cultural revolution in a field of activity where professional identity used to depend essentially on the mastery of technologies. If this technical dimension remains significant, it no longer suffices to define the different computer occupations, which suggests that they have gone beyond their initial phase. Now integrated into every area of society, they are more determined by their respective positions in the chain of services provided to users (development, administration, support).

If we consider the whole of the present training supply preparing for these basic occupations in the light of this situation, it may be observed that this supply targets either an occupation (maintenance and service technician in computer science for the AFPA) or an area of application (BTS in industrial computing for the technical high schools) or a technology (DUT in telecommunications and network engineering for the IUTs or higher technician in computer and telecommunications networks at the AFPA). However, a technological approach to training generally crosses over the different families of occupations. Thus, for the AFPA, which is presently involved in a process of revising its training streams and the corresponding qualifications and accreditations (cf. Box p. 3), the goal is to concentrate primarily on the basic occupations identified. Within such a framework, the areas of application and technological specificities would then define different training paths within a single qualification, through a system of electives. This occupation-based approach has the advantage of harmonising the qualifications, reducing their number and avoiding the risk that several qualifications cover the same job targets. More broadly, it would permit greater complementarity between the educational system's training streams and those of the AFPA.
The parallel study of all the basic computer occupations and the activities they include permits the identification of about twenty coherent skills units for the three families. These units will help to promote a policy of accrediting work experience. Thus, within the Help Desk structures, there is a unit for "call evaluation and foreground processing", the recognition of which would facilitate occupational mobility within the family of maintenance and service occupations. Ultimately, the combination of a training-centred culture and expertise in the analysis of work facilitates the definition of activities upstream from the technologies, so that the latter can serve to place competences in context without overshadowing them.

Olivier Liaroutzos (Céreq) and Marc Robichon (AFPA)

GLOSSARY OF TECHNICAL TERMS

- *Client/server architectures*: Computer architectures permitting network users to have access to the data and applications of the server information system.
- *Ethernet*: A standard communications technology used by more than 90 percent of existing local networks.
- *Help Desk*: Remote technical support.
- *"Object-oriented" languages*: Modern programming languages favouring the construction of programmes from reusable software components.
- *OEMs* (original equipment manufacturers): Companies specialised in the subcontracting of after-sales service for different computer manufacturers and in-house computer departments.
- *Rapid development*: A technique permitting the rapid development of a software programme in close collaboration with the user.
- *Simulation*: A technique allowing the appearance of a computer application to be tested rapidly.
- *Software integration*: Modularisation of software through the assembling of reusable software components.
- *Software package*: A standard software programme for one kind of needs that is subsequently parametred in function of the customer's particular characteristics.

FRENCH RESEARCH CENTRE FOR THE ANALYSIS OF OCCUPATIONS, VOCATIONAL EDUCATION AND TRAINING

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Administration: Céreq, 10 place de la Joliette, 13567 Marseille cedex 02. Tel (33) 4 91 13 28 28
Executive Publisher: Hugues Bertrand. Managing Editor: Philippe Ansart. Translator: Miriam Rosen
ISSN 1156 2366 Dépôt légal 2e trimestre 2000

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